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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/502,729	02/11/2000	Stephan Alan Cohen	YO999-573	5596

7590

11/06/2002

Rocco S Barrese Esq
Dilworth & Barrese
333 Earle Ovington Boulevard
Uniondale, NY 11553

EXAMINER

LOUIE, WAI SING

ART UNIT

PAPER NUMBER

2814

DATE MAILED: 11/06/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/502,729	COHEN ET AL.	
	Examiner	Art Unit	
	Wai-Sing Louie	2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 August 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-16 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-16 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-6 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Li et al. (US 2002/0020919) in view of Ibok (US 6,235,456).

With regard to claim 1, Li et al. disclose a diffusion barrier layer ([0020] to [0029] and fig. 2) for semiconductor devices having an upper surface and a lower surface and a central portion and comprising silicon, carbon, nitrogen, and hydrogen ([0024]). Li et al. teach the conductive material 32 should be surrounded by nitride to prevent diffusion of Cu into insulative material 40 and oxygen into Cu layer 32 ([0012] and fig. 2), but Li et al. do not disclose the nitrogen being non-uniformly distributed throughout the diffusion barrier layer 100. However, Ibok discloses a graded silicon oxynitride layer 108, which the ratio of silicon and nitrogen varies through the layer. The nitrogen is selective deposited in the layer, which changes throughout the top, bottom, or central portion of the layer (Ibok col. 5, line 64 to col. 6, line 8). Ibok teaches the graded nitrogen region is for the application of high mechanical strength, polish stop layer, and/or high resistance to diffusion of contaminant molecules (Ibok col. 2, lines 50-54). Ibok also teaches the graded nitrogen layer formed by CVD can be integrated easily in the manufacturing processes with minimal disruption (Ibok col. 6, lines 15-18). Therefore, it would

have been obvious to one with ordinary skill in the art to include a non-uniformly distributed barrier layer with a central portion is substantially devoid of nitrogen in Li's device in order to have the diffusion barrier to prevent the diffusion of Cu and have high mechanical strength.

With regard to claims 2-3 and 8-9, Light et al. modified by Ibok would have the upper and lower surface of the diffusion barrier layer, which is relatively thin compared to the central portion of the diffusion barrier layer (Ibok col. 6, lines 9-12).

With regard to claim 4-6 and 10, please see the description of record.

Claims 7 and 11-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (US 6,228,761) in view of Li et al. (US 2002/0020919) and Ibok (US 6,235,456).

With regard to claim 7, Ngo et al. disclose a semiconductor device (col. 4, line 35 to col. 6, line 48 and fig. 10) comprising:

- A substrate 40 containing conductive elements;
- A diffusion barrier layer 56 applied to at least a portion of the substrate in contact with the conductive metal 58. Ngo et al. do not disclose the diffusion barrier layer 56 having an upper and a lower surfaces and a central portion comprising silicon, carbon, nitrogen, and hydrogen with nitrogen being non-uniformly distributed throughout the diffusion barrier layer 56. However, Li et al. modified by Ibok, in claim 1 above, disclose the above-mentioned layers. Li et al. teach the silicon chemically bonded oxynitride and organic material would provide a barrier between the conductive metal and insulative material to prevent the diffusion of elements (Li [0021] and [0025]). Therefore, it would have been obvious to one

with ordinary skill in the art to provide the diffusion barrier layer having an upper and a lower surfaces and a central portion devoid of nitrogen. Doing so would prevent the diffusion of elements and damage the device.

With regard to claim 11-16, please see the description of record.

Response to Arguments

Applicant's arguments filed 8/28/02 have been fully considered but they are not persuasive.

- Reference Park (US 6,100,559) is no longer used as a secondary reference. The argument is moot.
- Applicant argues reference Ngo et al. do not disclose a diffusion barrier layer having an upper, lower, and a central portion. However, Ngo et al. modified by Light et al. and Ibok would meet all claimed limitations of claim 7.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

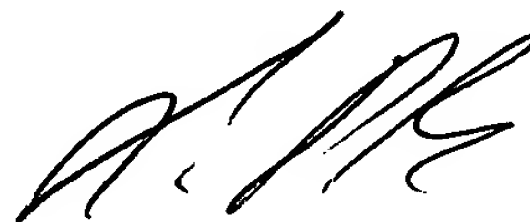
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wai-Sing Louie whose telephone number is (703) 305-0474. The examiner can normally be reached on 7:30 AM to 4:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

wsl

November 1, 2002



LONG PHAM
PRIMARY EXAMINER